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# CSC 569 – SPRING 2014

## SELECTED TOPICS IN AI

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**DR. MANAR HOSNY**

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### COURSE OBJECTIVES

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The purpose of this course is to introduce fundamental concepts of heuristics in solving various optimization problems with emphasis on metaheuristics. The topics include basic heuristic constructs (greedy, improvement, construction); metaheuristics such as simulated annealing, tabu search, genetic algorithms, ant algorithms and their hybrids.

By the end of this course students should be able to design and implement efficient algorithms to solve complex optimization problems across a diverse range of applications, such as networking, bioinformatics, routing and scheduling, etc.

### COURSE CONTENTS

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#### **PART I: COMMON CONCEPTS FOR METAHEURISTICS**

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- a) Optimization models and methods
- b) Main common concepts for metaheuristics
- c) Constraint handling and parameter tuning
- d) Performance analysis of metaheuristics

#### **PART II: SINGLE SOLUTION BASED METAHEURISTICS:**

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- a) Common concepts of fitness landscape analysis
- b) Local search
- c) Simulated annealing
- d) Tabu Search
- e) Iterated local search
- f) Variable neighborhood search



- g) Guided local search
- h) GRASP

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### **PART III: POPULATION BASED METAHEURISTICS**

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- a) Common concepts of population based metaheuristics
- b) Evolutionary algorithms
- c) Scatter Search
- d) Swarm Intelligence

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## **COURSE PLAN**

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### **WEEK 1 (3 FEB):**

- Course objectives, syllabus and plan
- Introduction

### **WEEKS 2 (10 FEB):**

- Part I-1

### **WEEKS 3 (17 FEB):**

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### **WEEKS 4 (24 FEB):**

- Part I-2

### **WEEKS 5 (3 MARCH):**

- Part II-1

### **WEEKS 6 (10 MARCH):**

- Part II-2

### **WEEKS 7 (17 March)**

- **Exam 1**



### **WEEKS 8 (24 March)**

- **Half term break**

### **WEEKS 9 (31 March)**

- 1 paper to be discussed on TS search, SA, LS, VNS, GRASP
- Part III -1

### **WEEK 10 (7 April)**

- Part III -2

### **WEEK 11 (14 April):**

- 2 papers to be discussed on GAs

### **WEEK 12 (21 April):**

- Part III -3

### **WEEK 13 (28 APRIL):**

- 1 paper to be discussed on swarm intelligence
- Part III-4

### **WEEK 14 (5 MAY):**

- Student Paper Presentation

### **WEEK 15 (12 MAY):**

- Project discussion

### **WEEK 16 (19 MAY):**

- Project Presentation

### **WEEK 17 (26 MAY):**

- **Final Exam**



## EVALUATION

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1. **1 Midterm 20**
2. **Participation 5**
  - Class papers discussion (1 each) → 4
  - Paper presentation discussion → 0.5
  - Project presentations discussion → 0.5
3. **Paper Presentation 15**
  - Compare two metaheuristics solution methods on the same problem
4. **Project 20**
  - Solve a selected problem (to be announced later) using one of the studied metaheuristics.
  - Provide a document, demo, and presentation
5. **Final 40**

## REFERENCES

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### **Text Book:**

- Metaheuristics from Design to Implementation, El-Ghazali Talbi- Wiley, 2009

### **Additional References:**

- Handbook of Metaheuristics, Gendreau & Potvin (Eds.), second edition, Springer, 2010
- Essentials of Metaheuristics, Sean Luke, Lulu, First Edition, 2009